

California Energy System Transformation

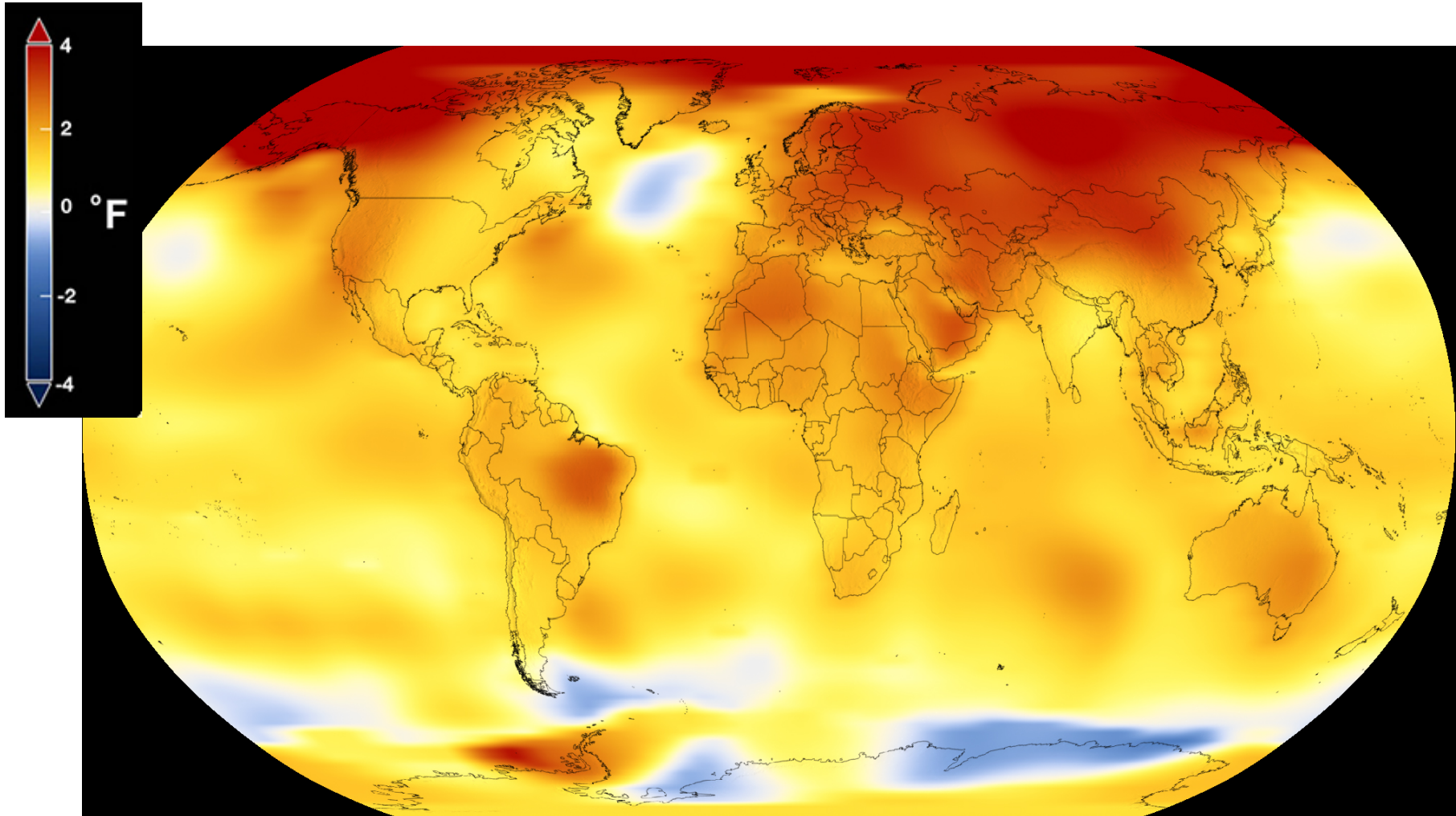
Dr. Robert Weisenmiller
Chair, California Energy Commission

DataCenterDynamics > Webscale
San Francisco, CA
June 25, 2018



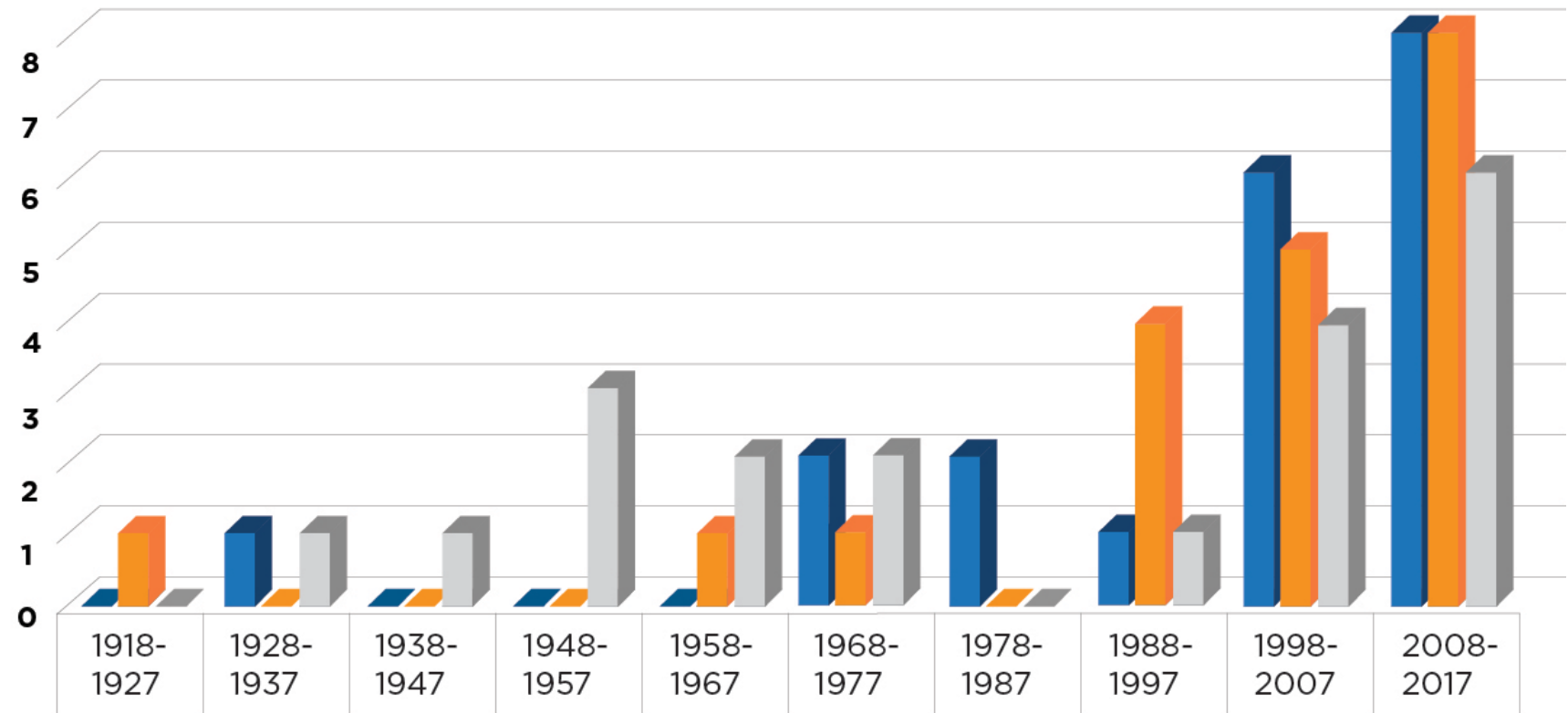


Global Average Temperature: 1951-1980 v. 2013-2017





Climate Adaptation: Preparing for Future Fires in California

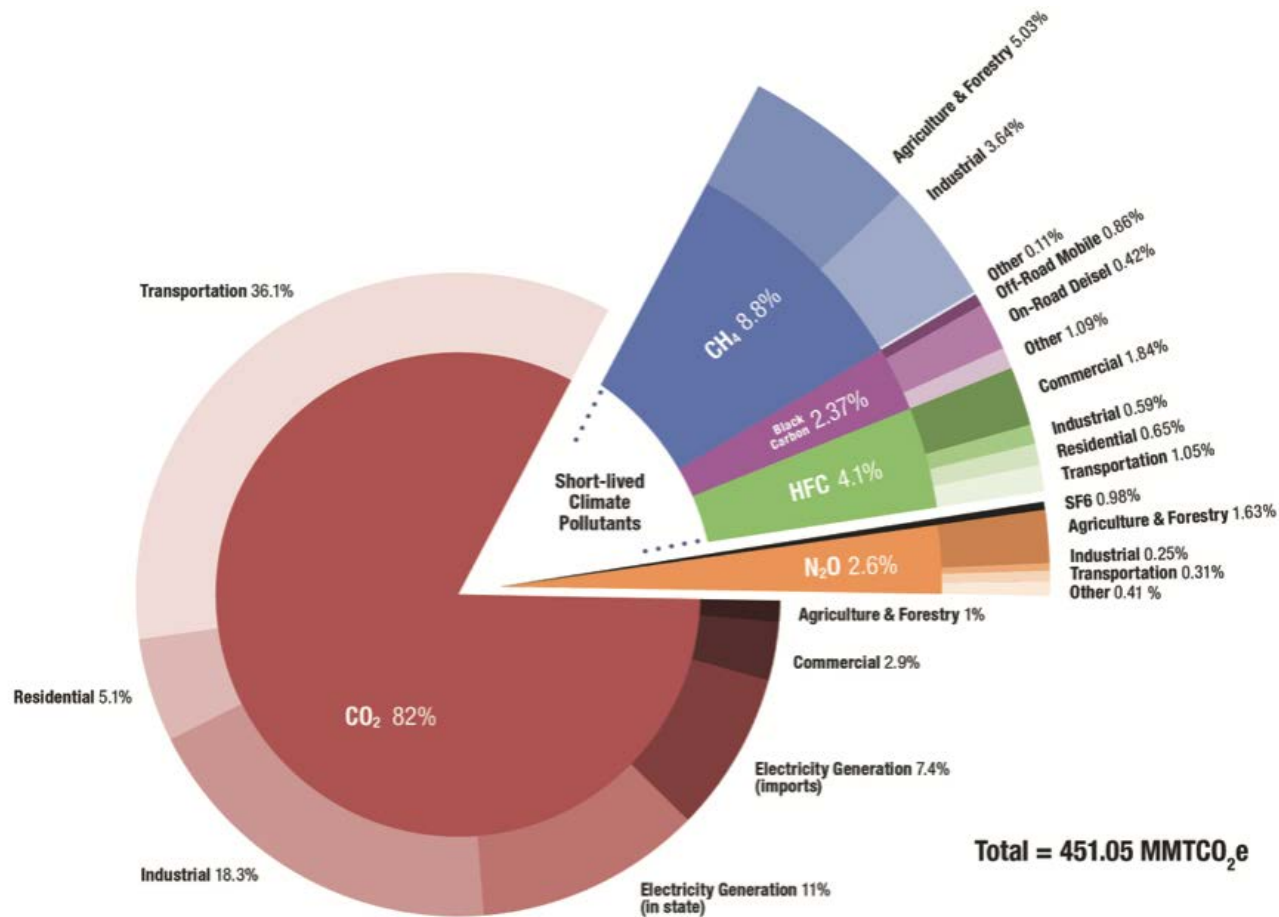


Source: Cal Fire





California 2015 GHG Emissions



Source: California Energy Commission staff using data from CARB's 2017 GHG Emissions Inventory of 0215 emissions available at http://www.energy.ca.gov/2017_energyppolicy/

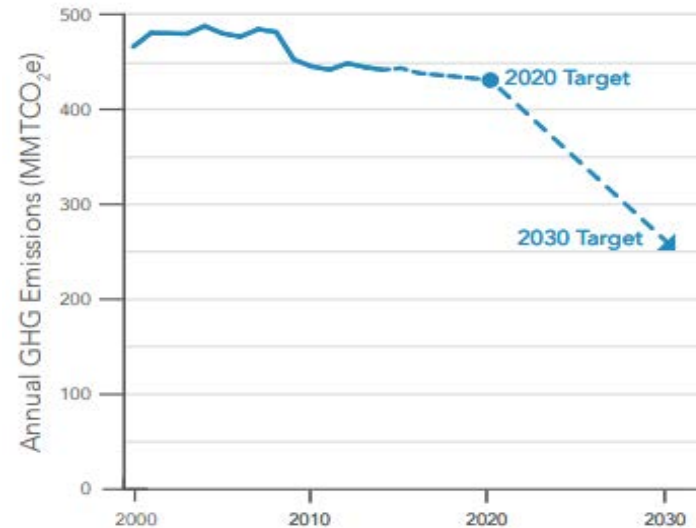


California's Major GHG Reduction Goals

- **2020:** Reduce to 1990 level (*AB 32*)
- **2030:** Reduce to 40% below 1990 level (*SB 32*)
- **2050:** Reduce to 80% below 1990 level (*Governor Brown Executive Order*)



CALIFORNIA'S PATH FORWARD



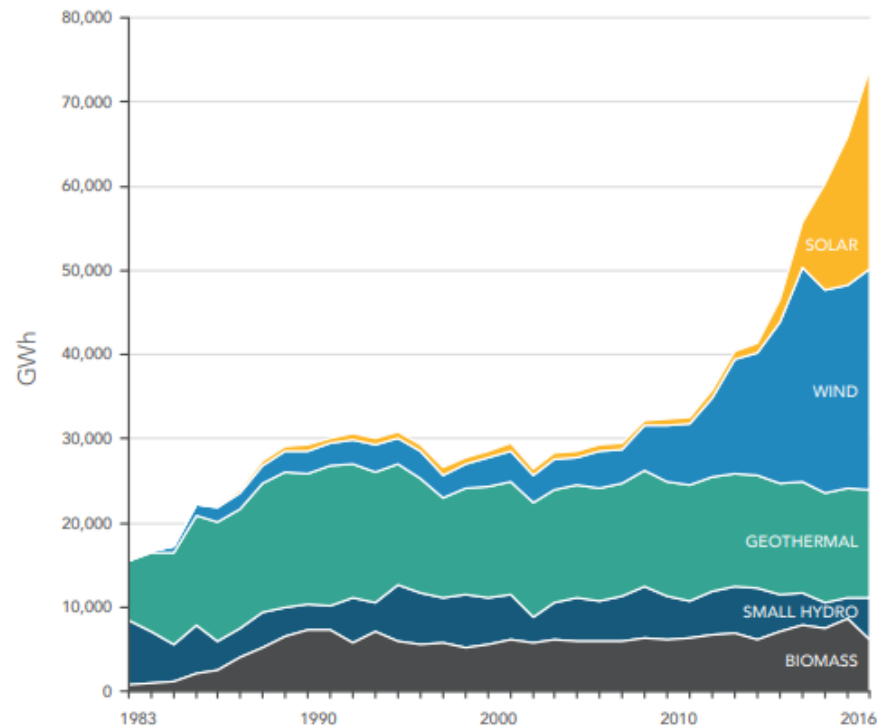
- **Zero-Emission Vehicle Executive Order (2018)**
 - 5 million ZEVs by 2030
 - 250,000 EV charging stations by 2025
 - 10,000 to be DC fast chargers
 - 200 hydrogen fueling stations by 2025



SB 350 (2015)

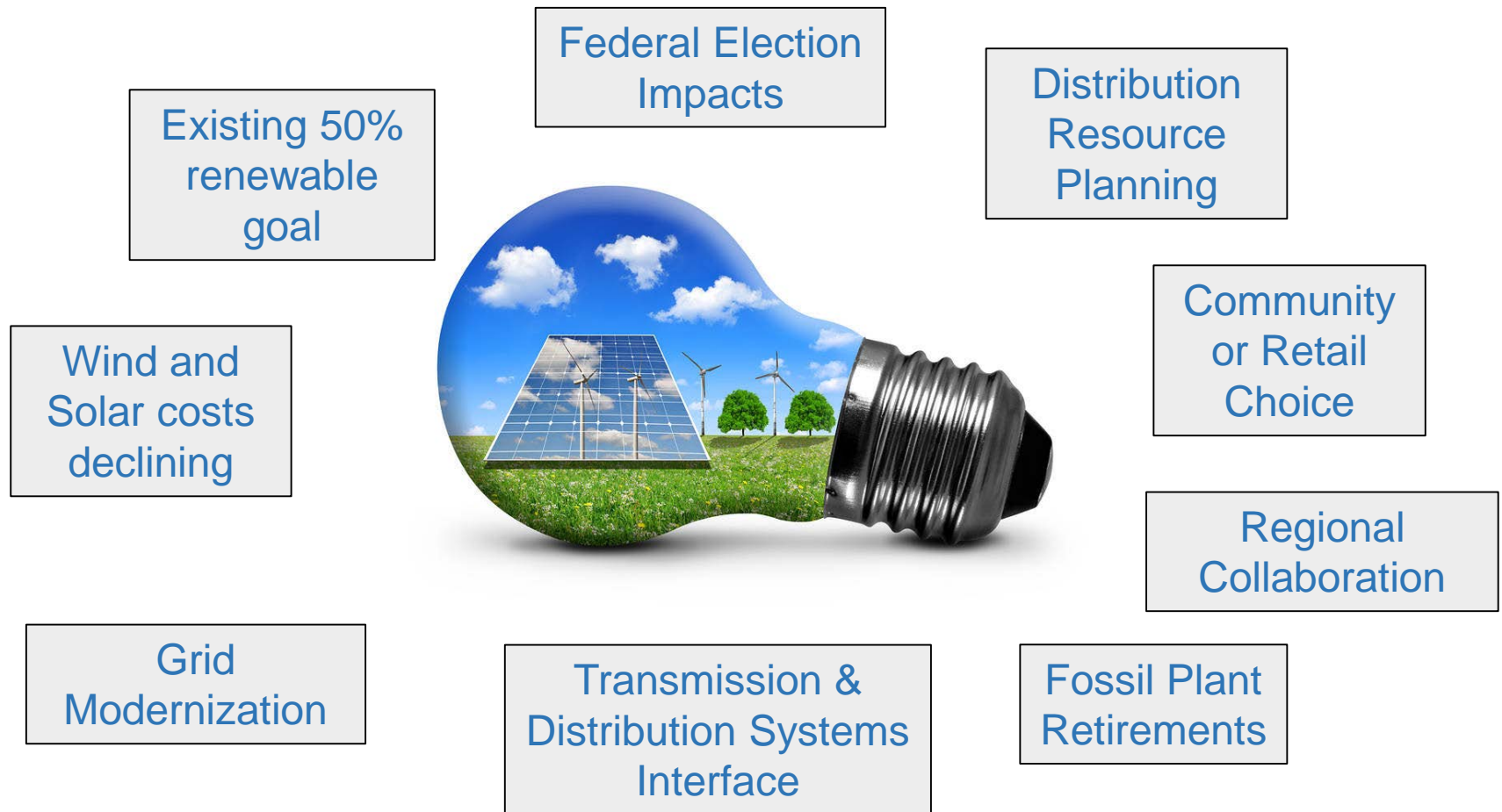
- 50% Renewable Portfolio Standard by 2030
- Double Energy Efficiency by 2030
- Regionalized Grid
- Low-Income Barriers Report
- Transportation Electrification

INCREASING RENEWABLE ELECTRICITY GENERATION (IN & OUT OF STATE)



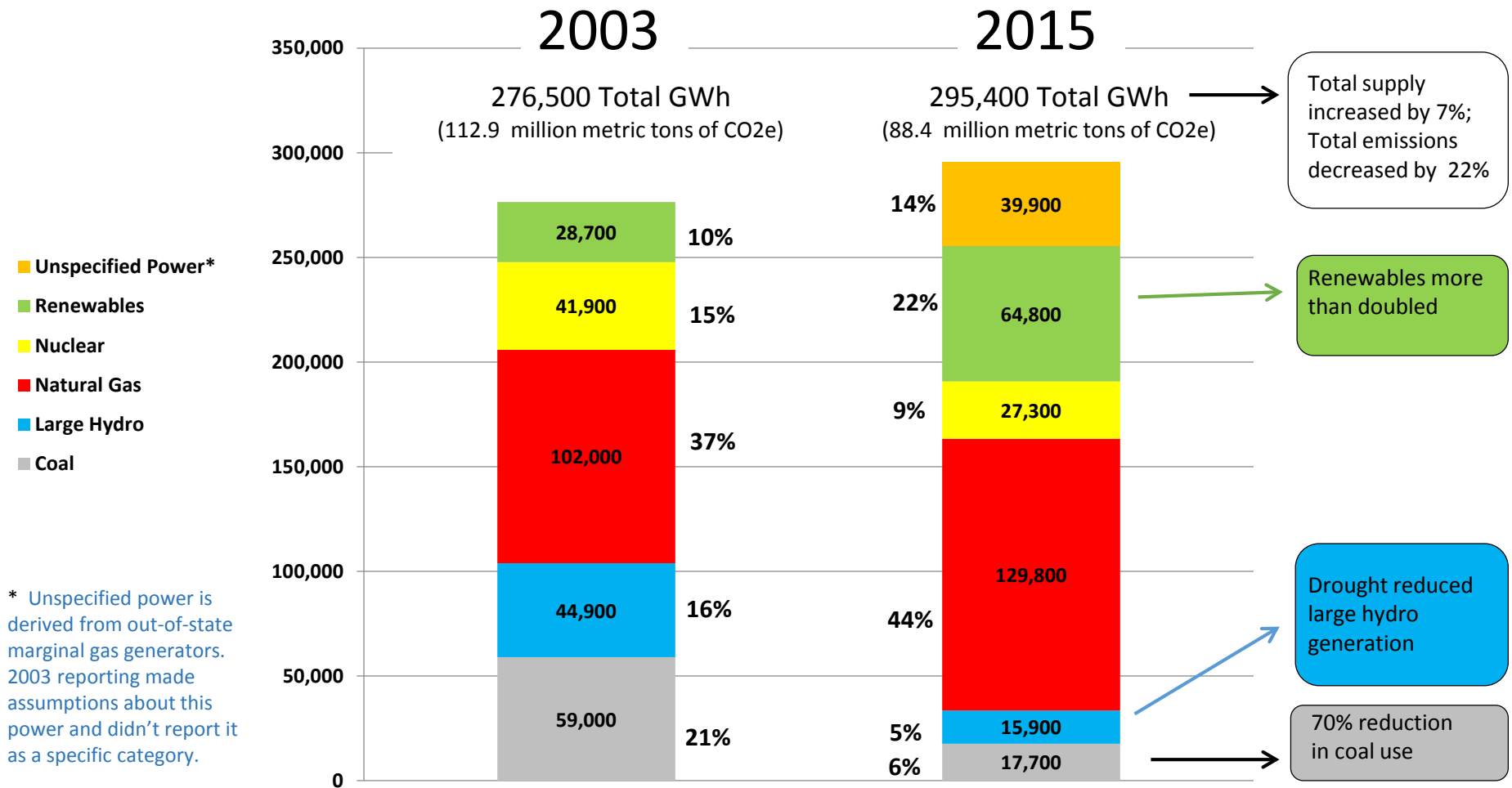


Unprecedented Change in the Electric Industry





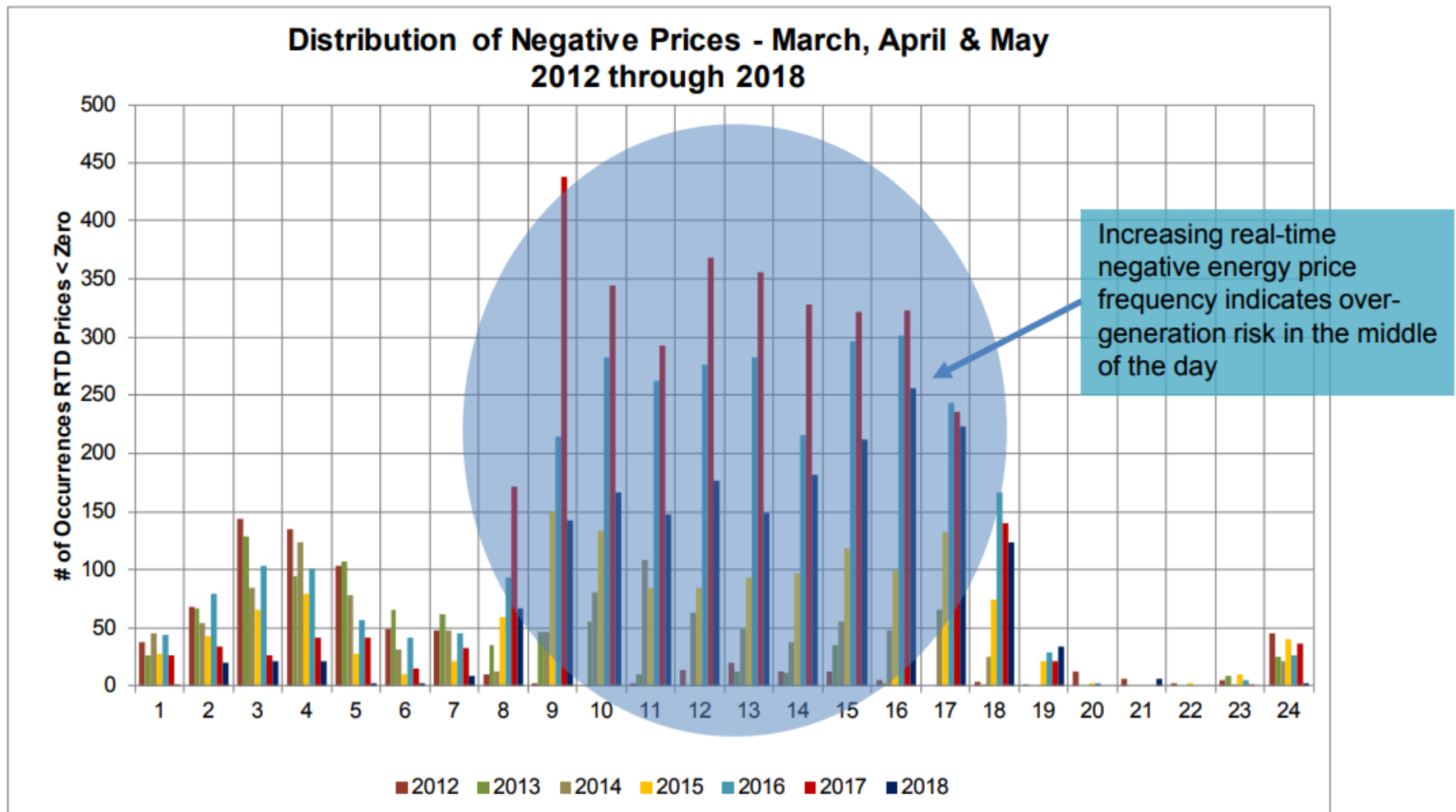
CA Power Mix Changes



Sources: Energy supply mix from the Energy Commission's Total System Power. See http://www.energy.ca.gov/almanac/electricity_data/total_system_power.html. Emissions data from Air Resources Board's GHG Emission Inventory. See <https://www.arb.ca.gov/cc/inventory/inventory.htm>.



Opportunities for Responsive Demand and Storage





California's Energy Storage Mandate

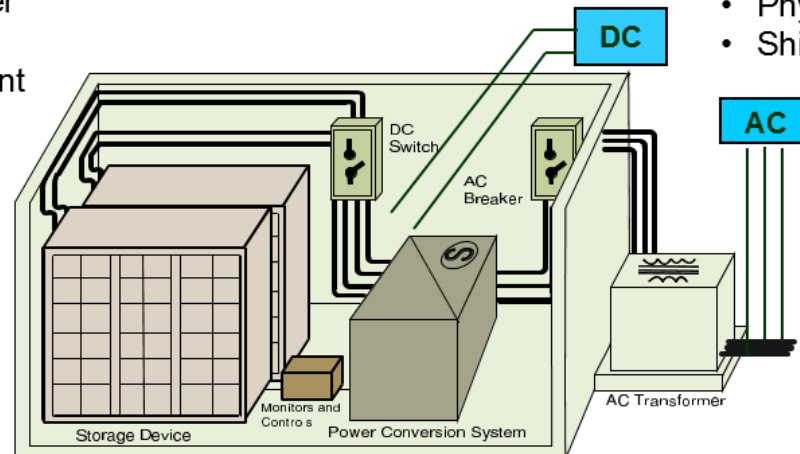
- **AB 2514 (2010):** top three investor-owned utilities must procure 1.3 GW of energy storage power by 2020 (online by 2024)
 - Additional 500 MW of storage

Power Conditioning System

- DC to AC conversion
- Charging control
- Reactive power management
- Integration point to the grid

Balance of Plant

- Data acquisition and controls
- Thermal management
- Physical structure
- Shipping and Installation

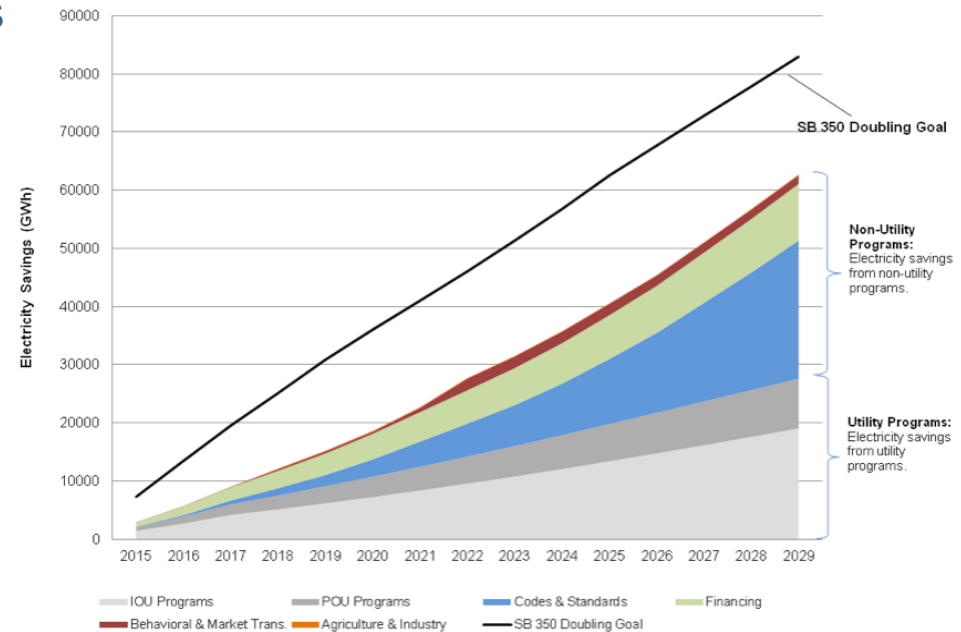


All components must be safe, reliable, low-cost, and seamlessly integrated



Data Center Efficiency

- **Title 24 – Building Energy Efficiency Standards (2016):**
 - Includes some design requirements, such as hot/cold aisle containment
 - Focus on HVAC, not on servers or overall operations
 - 2019 Standards added requirement for fault detection devices for economizers at data centers
- **SB 350 EE Doubling Targets:**
 - Potential Data Center savings likely to be included in 2019 update to Doubling Targets
 - ❖ Depends on market readiness studies and
 - ❖ Cost-effectiveness of new data center technologies



Source: California Energy Commission staff, September 2017



Data Center Efficiency

- **Server Standards:**

- Greatest opportunity for efficiency gains
- Large-Scale Servers:
 - Not currently regulated at state or federal level
- “Small-Scale” Servers:
 - ❖ Currently regulated by CEC in Title 20
 - *Definition:* 20 CCR §1602(v)
 - *Regulations:* 20 CCR §1605.2(v)(5) & (6)
 - ❖ Essentially a server that looks like a desktop but is designed to be a storage host for other computers
 - ❖ CEC will review savings potential based on success of computer standards and consider updating them



Small-Scale
Servers



300,000 regulated
in California



California's Building Energy Use Benchmarking Regulations (AB 802)

- Went into effect June 1, 2018
- Benchmarking and public disclosure for buildings larger than 50,000 ft²
 - Data reported using ENERGY STAR Portfolio Manager
- Utilities must provide building-level energy use data to building owners, agents, and operators
- Local benchmarking and public disclosure programs exceeding state minimum:
 - San Francisco
 - Berkeley
 - Los Angeles





Power Plant Siting

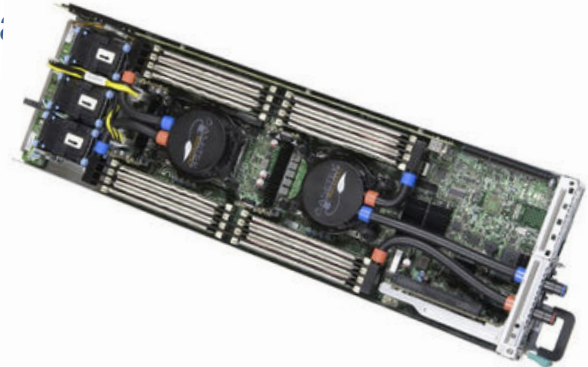
- **Santa Clara Data Center (SC-1):**
 - Small Power Plant Exemption (SPPE) granted in 2012 for a data center generating 72 MW from 32 emergency diesel-fired internal combustion engines
- SPPE may be granted if:
 - Capacity does not exceed 100-MW; and
 - No substantial adverse impact on the environment or energy resources will result from the construction or operation of the proposed facility.
- Once exemption is granted, CEC does not maintain active oversight of project, except for expansions
- Project added 27 MW in 2015 in the form of 12 back-up diesel generators for a total of 99 MW capacity





CEC Funded RD&D

- **UC Riverside**
 - “Smart” workload balancing server algorithms
 - Utilizes each server at most efficient capacity and puts unused servers in deep sleep
 - Potential to save over 1,000 GWh annually
- **Asetek: Liquid Cooled Server Racks**
 - Reduces data center electricity by 20-30%
 - Reduces energy needed for cooling by 60-80%
- **UC San Diego (Approved May 2018)**
 - Project also received support from U.S. DOE to develop and demonstrate a new energy efficient data center architecture based on optical switching
 - ❖ Delivers more bandwidth
 - ❖ Processes more information
 - Will help double energy efficiency in data centers by 2030





Additional Resources

- California's Title 24 Building Energy Use Standards
- California's Title 20 Appliance Energy Use Standards
- LBNL Center of Expertise for Energy Efficiency in Data Centers
- DOE's Best Practices Guide for Energy-Efficient Data Center Design



Questions?

Thank you!